

UNCLASSIFIED

Security Classification

AD-742516

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) U.S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE U.S. Army Test and Evaluation Command Systems Engineering Test Operations Procedure - "Fire Hoses and Assemblies."			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final			
5. AUTHOR(S) (First name, middle initial, last name)			
6. REPORT DATE 20 April 1972		7a. TOTAL NO. OF PAGES 10	7b. NO. OF REFS 7
8a. CONTRACT OR GRANT NO.		8b. ORIGINATOR'S REPORT NUMBER(S) TOP 10-2-050	
b. PROJECT NO.			
c. AMCR 310-6		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Headquarters U.S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	
13. ABSTRACT <i>See report</i> Describes a method for evaluation of fire hose and fire hose assembly operational and performance characteristics. It identifies supporting tests, facilities, and equipment required. It provides procedures for leakage, resistance to vacuum, fitting retention, pull resistance, coupling compatibility, and coupling reattachability tests.			

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Fire Hose Fire Fighting Equipment						

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U.S. ARMY TEST AND EVALUATION COMMAND
SYSTEM ENGINEERING TEST OPERATIONS PROCEDURES

AMSTE-RP-702-109

*Test Operations Procedure 10-2-050

20 April 1972

FIRE HOSES AND ASSEMBLIES

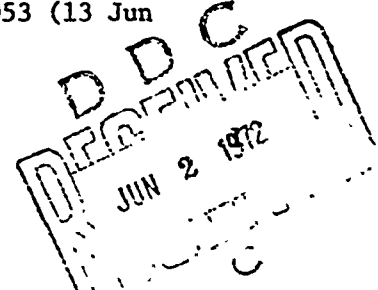
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SECTION I
GENERAL

1. Purpose and Scope. This TOP describes test procedures for evaluating the operational and performance characteristics of fire hoses and assemblies. Equipment covered includes: hoses and fittings consisting of hose couplings, nipples, and nipple flanges. From the tests listed in Section II, the test director can select those that will satisfy the requirements for the particular test item and the particular test type (i.e., engineering test, initial production test, etc.). Test objectives are to determine conformance of the test items to QMR, MN or other suitability criteria. For initial production tests, scope will be in accordance with the contractual provisions of the applicable military specifications and suitability criteria established by the test directive. This document provides for simulated environmental testing but does not include service testing or environmental testing at climatic test sites.

*This TOP supersedes MTPs 10-2-052 (19 May 69) and 10-2-053 (13 Jun 1969), including all changes.

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2. Background. A need exists for flexible fire hoses and hose assemblies to be used by Army personnel in fighting fires which are too large to be extinguished by small hand or back-carried fire extinguishers, or where access to the appropriate extinguishing agent can be had only at permanently-installed hose coupling points which may be remote from the fire. Two general types of couplings or fittings are used: reattachable and non-reattachable. Reattachable couplings can be easily assembled on the hose without the use of special tools and removed and re-attached to new hose as required. Non-reattachable couplings require the use of special tools and cannot be reused. The six general types of fire hoses and hose assemblies and their use are described in table 1.

Table 1. Fire Hose Assembly Types

General Type and Classification	Extinguishing Agents Handled	General Hose Construction	Mode of Use
"Chemical Engine" Fire Hose Assemblies [Class I]	1) Water Solution (anti-freeze) 2) Water Solution (Soda-acid) 3) Water Solution (loaded stream) 4) Foam 5) Dry Chemical 6) Vaporizing Liquid 7) Coarse powder (for metal fires)	a) Rubber inner tube (lining) b) Fabric reinforcement c) Rubber cover (jacket)	Pressure Discharge
Carbon Dioxide Fire Hose Assemblies [Class II]	Carbon Dioxide	a) Rubber inner tube (lining) b) Wire braid reinforcement c) Rubber cover (jacket)	Pressure Discharge
Woven-Jacketed Rubber Lined Fire hose Assemblies [Class III]	Water	a) Rubber, or rubber-coated fabric tube (lining) b) Braided fabric cover (jacket)	Pressure Discharge

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Table 1. Fire Hose Assembly Types (Continued)

General Type and Classification	Extinguishing Agents Handled	General Hose Construction	Mode of Use
High-Pressure Water Hose Assemblies [Class IV]	Water	a) Rubber inner tube (lining) b) Fabric reinforcement c) Rubber cover (jacket)	Pressure Discharge
Unlined Fire Hose Assemblies [Class V]	Water	Woven Flax Fiber	Pressure Discharge
Water Suction Hose Assemblies [Class VI]	Water	a) Rubber inner tube (lining) b) Fabric reinforcement combined with a steel wire helix c) Rubber cover (jacket)	Vacuum Suction

3. Equipment and Facilities. Equipment and facilities required are defined in the documents listed in Section II and Section III.

SECTION II TEST PROCEDURES

4. Supporting Tests. Subtests (generally in preferred order of completion with respect to high-risk, short duration) to be considered in formulating a test plan are listed below with references.

TEST SUBJECT TITLE		PUBLICATION NO.
a. Pre-operational Inspection		10-3-500
(1) Operator Training and Familiarization		10-2-501
(2) Photographic Coverage		7-3-519
b. Physical Characteristics		10-2-500
(1) Minimum thickness of one tube and one cover specimen after buffing		FED-STD-601 Method 2011

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<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NO.</u>
(2) Tensile Strength and Elongation Tests	
(a) Sample preparation	Methods 1011, 1111 and 4111
(b) Items not subject to aging, im- mersion or exposure to sunlight	Methods 4111; 4121
(c) Items subject to accelerated aging	Methods 7221; 4111 and 4121
(d) Items exposed to simulated sunlight	Method 7311, 4111 and 4121
(e) Items subject to immersion	Methods 6111, 4111 and 4121
(f) Permanent Elongation Test	Method 4411
(3) Adhesion Tests	Methods 8011, and 8021
(4) Burst Strength Tests	
(a) Prior to immersion	Method 10011
(b) After immersion	Method 6011 and 1011
(5) Change in Volume Test	Method 6211
(6) Soluble Matter Test	Method 6621
(7) Flexibility Test	Method 5711
(8) Helix wire Test-Tensile strength	FED-STD-151B Method 211.1
c. Safety	10-2-508
d. Hydrostatic Tests	
(1) Bursting strength, straight specimen	FED-STD-601 METHODS: 10011
(2) Bursting strength, curved specimen	10021
(3) Proof pressure	10211
(4) Hold test, straight specimen	10221
(5) Hold test, curved specimen	10231
(6) Elongation or contraction	10311
(7) Expansion, circumference	10321
(8) Twist	10331
(9) Warp	10341
(10) Rise	10351
(11) Kink	10361
(12) Coupling retention	FED-SPEC-ZZ- H-451D, AMEND 3, Para 4.6.1.7
(13) Leakage test (refer to para 5)	

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<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NO.</u>
e. Performance Tests	
(1) Friction or Head loss	FED-SPEC-ZZ- H-451D Para 4.6.7
(2) Resistance to vacuum (refer to para 6)	
(3) Fitting retention (refer to para 7)	
(4) Pull resistance (refer to para 8)	
(5) Mating of hose assembly couplings (refer to para 9)	
(6) Reattachability of couplings (refer to para 10)	
f. Environmental Testing	
(1) Temperature	MIL-STD-810B Method 501 AR 70-38
(2) Sunshine	4-2-826
(3) Rain	2-2-815
(4) Humidity	4-2-820
(5) Fungus	4-2-818
(6) Salt Fog	MIL-STD-810B Method 509
(7) Dust Test	Method 510
(8) Vibration	4-2-804
(9) Rough Handling	4-2-602
g. Transportability	
(1) Road, Rail, Marine	10-2-503
(2) Air	7-2-515
h. Human Factors Evaluation	10-2-505
i. Reliability	AMCP 702-3
Confidence Intervals and Sampling Size	3-1-002
j. Durability (Endurance Testing)	10-2-502
k. Maintenance Evaluation	10-2-507
l. Value Analysis	USAMC SUPPL 1 to AR 11-26

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SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Leakage Test.

a. Objective. To determine the amount of leakage incurred when test item is subjected to high pressures.

b. Method. A section of the test item (including couplings) approximately 48 inches in length is obtained for this test. One end of the test item is sealed by a cap or blank coupling. The opposite end is attached to a pump capable of providing and maintaining a test pressure of 75 psi after 30 seconds of operation. The pump is operated to provide a 75 psi hydrostatic pressure to the test item for a period of 20 minutes. At the end of 20 minutes the pressure is released. The amount of water leakage occurring during the last ten minutes of the test period is collected in a trough and measured.

c. Data Required.

- (1) Test item nomenclature and type.
- (2) Length of test item and collection trough.
- (3) Applied pressure and duration of application.
- (4) Water leakage measured and corresponding time period.

d. Analytical Plan. The rate of water leakage per square inch of test item is computed and compared with the requirements of the MN to determine conformance to specifications.

6. Resistance to Vacuum.

a. Objective. To determine if the test item will collapse when subjected to stated internal low pressure differentials or vacuum.

b. Method. A section of test item (including coupling) approximately 48 inches in length is obtained for this test. One end of the test item is sealed with a transparent cap permitting visual inspection of the interior. The opposite end is attached to a suction pump. The pump is operated to provide an internal low pressure or vacuum equivalent to 20 inches of mercury for a period of five minutes. During this time period, the interior of the test item is visually inspected for any signs of collapse.

c. Data Required.

- (1) Test item nomenclature and type.

- (2) Length of test item.
- (3) Vacuum or low pressure applied and time duration.
- (4) Degree of test item collapse observed.

d. Analytical Plan. The degree of test item collapse observed is compared with the requirements of the MN to determine conformance to specifications.

7. Fitting Retention.

a. Objective. To determine the fitting retention of the test item when subjected to mechanical stress.

b. Method. A 25-foot section of the test item (including couplings) is used for this test. The test item is rigidly extended between the pump and a fixed cap fitting allowing for a maximum of 18 inches of sideways motion at the mid-section. The test item is indexed at the points where it joins the couplings. The pump is operated to provide a hydrostatic pressure of 75 psi and the mid-section of the hose moved laterally a distance of 18 inches each side of center a minimum of ten times. The distances between the indexes and the couplings are measured and the hydrostatic pressure is released.

c. Data Required.

- (1) Test item nomenclature and type.
- (2) Length of test item.
- (3) Applied pressure and duration of application.
- (4) Lateral movement distances and number of times moved.
- (5) Measured distances between index markings and couplings.

d. Analytical Plan. The measured distances, under mechanical stress, between the index markings and the couplings are compared with the requirements of the MN to determine conformance to specifications.

8. Pull Resistance.

a. Objective. To determine the pull resistance of test item and couplings.

b. Method. A 25 foot section of the test item (including couplings) is used for this test. The test item is rigidly extended

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between a fixed point and a tension testing machine. The test item is indexed at the points where it joins the couplings. Tension is applied to the test item until the specified pull in pounds is reached. The distances between the indexes and the couplings are measured and the tension released.

c. Data Required.

- (1) Test item nomenclature and type.
- (2) Length of test item and type of tension testing machine.
- (3) Applied tension and duration of application.
- (4) Measured distances between index markings and couplings during tension.
- (5) Test item breakage or coupling separation, if applicable.

d. Analytical Plan. The measured distances, under tension, between the index markings and the couplings are compared with the requirements of the MN to determine conformance to specifications.

9. Mating of Hose Assembly Couplings.

a. Objective. To determine the compatibility of test item assembly couplings.

b. Method. A 25-foot section of the test item (including couplings) is used for this test. The test item is coupled to all equipment fittings with which it would be normally used in service, using all special tools and equipment provided for this purpose. These functions are performed by trained test personnel who record comments on the compatibility of the test item coupling.

c. Data Required.

- (1) Test item nomenclature and type.
- (2) Comments of trained test personnel concerning:
 - (a) Ease of coupling and uncoupling.
 - (b) Adequacy of special tools and equipment.
 - (c) Number of personnel required.
 - (d) Any evidence of defects or malfunctions encountered.

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d. Analytical Plan. The comments of the test personnel are summarized, analyzed and compared with the requirements of the MN to determine conformance to specifications.

10. Reattachability of Couplings.

a. Objective. To determine the adequacy of reattachable test item couplings.

b. Method. Reattachable test item couplings which have successfully completed the tests of paragraphs 7, 8 and 9 are used in this test. The reattachable couplings are removed from the sections of the previously tested test item and installed on new sections of the test item. These new sections are subjected to the procedures of paragraphs 7, 8 and 9 and any failures or discrepancies recorded.

c. Data Required.

- (1) Reattachable test item nomenclature and type
- (2) Difficulties encountered in removing and reinstalling reattachable test item.
- (3) Results of testing using procedures of paragraphs 7, 8 and 9.

d. Analytical Plan. The recorded data are analyzed and compared with the requirements of the MN to determine conformance to specifications.

Recommended changes to this publication should be forwarded to Commanding General, U.S. Army Test and Evaluation Command, ATTN: AMSTE-ME Aberdeen Proving Ground, Maryland 21005. Technical information related to this publication may be obtained from the preparing activity, Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-MT-DM, Aberdeen Proving Ground, Maryland 21005. Additional copies of this document are available from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314. This document is identified by the accession number (AD No.) printed on the first page.

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APPENDIX
REFERENCES

1. AR 70-38, "Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions."
2. USAMC Supplement 1 to AR 11-26, "Value Engineering."
3. AMCP 702-3, "Quality Assurance - Reliability Handbook."
4. FED TEST METHOD STD NO. 151B, "Metals, Test Methods."
5. FED TEST METHOD STD NO. 601, "Rubber: Sampling and Testing."
6. Federal Specification ZZ-H-451D, "Hoses, Fire, Woven Jacketed, Rubber or Cambric Lined, with Couplings", including amendment 3.
7. MIL-STD-810B, "Environmental Test Methods", including notices 1 thru 4.